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Sudanese Banking Sector and Stress Testing

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Abstract

The repercussions of the 2008 Global Financial Crisis helped to reconsider the foundations used in assessing the banks' withstand potential crises. In 2009, the BCBS issued a document entitled "Principles for Sound Stress Testing Practices and Supervision" as a basis for early evaluation of the performance of banking institutions and their ability to overcome sudden shocks and crises. The study aims to examine the ability of the Sudanese Banking Sector to pass stress testing and withstand sudden shock in light of the Basel II standards of stress test. The methodology was based on analyzing the performance of Sudan's economy, consolidated balance sheet, and financial soundness indicators of the banking sector (2005-2021). Additionally, it was based on a scenario designed for reverse stress testing (2022-2025). The results show that the Sudanese banking sector failed to bear sudden shocks and pass the stress testing due to its lack of commitment to applying the supervisory standards of Basel II. The war that broke out in the state of Khartoum on April 15, 2023, led to a deterioration in the political and economic conditions. It is expected to reduce the banking sector's power to absorb shocks. The paper recommends the Central Bank of Sudan follow up on the commitment of banks to apply the stress testing and financial soundness standards recommended by Basel II, especially capital adequacy, liquidity requirements, and political risk. Furthermore, the implementation of contractionary monetary policies serves to reduce inflationary pressures, which helps banks avoid credit and market risks.

Keywords: banking sector, stress testing, soundness indicators, Sudan economy

1. Introduction

One lesson learned from the economic and financial crises in the modern era, most notably the 2008 global financial crisis, is that it led to a review of the financial foundations and standards through which the competence of banking and financial institutions is evaluated to confront risks and shocks. Following the housing bubble crisis in the United States, many banks were exposed to credit risk, which forced the authorities (Federal Reserve and Central Banks) to take measures to avoid them from collapsing. However, many of them went bankrupt due to failure to manage banking risk rationally. This situation prompted the Bank for International Settlements through the Basel Committee on Banking Supervision(BCBS) in 2009 to issue a document entitled " Principles for Sound Stress Testing Practices and Supervision" as a basis for early evaluation of banking institutions' performance and their ability to overcome sudden shocks and crises. The paper tests the extent of the Sudanese banking sector's ability to overcome stress testing within the economic and political conditions that Sudan witnessed during 2005-2021 and beyond.

2. Literature Review

2.1 A Brief Review of the Latest 5 Global Financial Crises

The modern global economy was exposed to five of the most serious financial and economic crises, which cast a black shadow on the performance of the banking sector all over the world. These crises include:

2.1.1 British Credit Crisis of 1772-1773

This crisis originated in London and quickly spread to the rest of Europe in the mid-1760s when the British Empire amassed enormous wealth through its colonial possessions and trade. This accumulation of wealth sparked an aura of excessive optimism and a period of rapid credit expansion by many British banks. On June 8, 1772, Alexander Fordyce - one of the most famous partners of the British banking house - went out to France to escape from paying his debts, as the news spread rapidly among the creditors leading to a banking panic in England. The creditors began to gather for a long time in front of the British banks. They formed long lines and demanded immediate full cash withdrawals and the famous bankruptcy crisis occurred (Kosmetatos, 2019).

2.1.2 The Great Depression 1929-1939

The Great Depression occurred in 1929. It is considered the worst economic and financial disaster that industrialized countries have experienced in history. Many countries believe that it resulted from the collapse of the "Wall Street" stock exchange in 1929. It was later exacerbated by the bad political decisions taken by the government of the United States to control the crisis (History Channel, 2023). The recession lasted about 10 years till 1939, resulting in huge losses in income, raising unemployment to a high rate in the United States reaching 25% in 1933, and undermining the wheel of production, especially in industrialized countries.

2.1.3 The Oil Price Crisis 1973

The oil price shock broke out when Arab oil-producing countries (members of the Organization of the Petroleum Exporting Countries (OPEC)) decided to take revenge on the United States for its sending military supplies to the Israeli occupation state in its war with Arab countries which is known as the “Fourth Arab-Israeli War of October 1973” At that time, OPEC countries announced an oil embargo on exports to the United States and its allies. This decision caused a huge oil shortage and a sharp rise in the prices of oil and its derivatives. As a result, the economies of the United States and many other developed countries were exposed to crisis (Liewellyn,1983).

2.1.4 The Asian Economic Crisis 1997

The Asian economic crisis began in 1997. Thailand was a developing and stimulating economy to attract speculative capital inflows from developed countries. This optimism encouraged the rest of East Asia countries (Indonesia, Malaysia, Singapore, Hong Kong, and South Korea) to excessive increase in credit. However, these capital inflows were not used effectively and Thailand failed to repay. The crisis rapidly spread to Asian tigers leading to a lot of debt that accumulated in these economies. In July 1997 as a result of citing a lack of foreign reserves, the Thai government was forced to leave the fixed exchange rate policy. "Baht" became floating against the US dollar. This led to sharp turmoil in the Asian financial markets. A huge scale of funds escaped out of those countries. As panic spread in the financial markets and investors became increasingly concerned about the possible loss (Derg, 1999).

2.1.5 The Global Financial Crisis 2007-2008

BCBS (2009) indicated that the main reason behind the financial turmoil in the United States of America attributed to the distortions that afflicted the banking and financial sector. The application of fragile and permissive monetary and fiscal policies in providing credit to the real estate sector in advanced economies led to the bursting of the housing bubble gradually.

Easy terms and low charges on housing loans in the United States stimulated everyone who does not have a house to get one. The housing supply increased and the market value sharply decreased. The debtors realized that even if they obtained housing and completed the payment to the bank, the market value of the housing is much less than the value that they would pay to own it. As the market value of the real estate declined, the debtors refrained pay the installments to the banks. When the client becomes insolvent or refuses to pay, the bank has the right to sell the collateral and liquidate the asset to recover its funds. This is exactly what banks have done. The supply of real estate increased once again to the point that its market price became not cover the principal of the housing loans. Lehman Brothers collapsed and ragged many US banks and institutions with it. The mortgage bubble occurred, causing the global financial crisis.

The lessons learned from past crises pushed Basel Committee on Banking Supervision (BCBS) in 2009 to publish principles for sound stress testing practices and banking supervision. These principles were built to reduce and mitigate banks’ exposure to risk as well as bridge the gap in banking practice.

2.2 Stress Testing in Theory and Practice

Since the global financial crisis of 2007, many international, regional, and local supervisory bodies have reformulation and crystallization of theoretical and practical foundations of stress testing that enable banking and financial institutions to carry out early tests to stand on their ability to withstand sudden shocks and crises. Those bodies include the World Bank (WB), the International Monetary Fund (IMF), the Arab Monetary Fund(AMF), the Islamic Financial Services Board(IFSB), the Bank for International Settlements (BIS), the Basel Committee on Banking Supervision (BCBS), the European Central Bank (ECB), and the Central Bank of Sudan (CBOS).

State Bank of Pakistan (2005) defined stress testing as “a process that provides information on the behavior of the financial system under a set of exceptional, but plausible assumptions. Its techniques provide a way to quantify the impact of changes in several risk factors on the assets and liabilities of the institution”.

BCBS (2009) defined stress testing as “an important risk management tool that is used by banks as part of their internal risk management and, through the Basel II capital adequacy framework, is promoted by supervisors. Stress testing alerts bank management to adverse unexpected outcomes related to a variety of risks and indicates how much capital might be needed to absorb losses should large shocks occur. While stress tests indicate the appropriate level of capital necessary

to endure deteriorating economic conditions, a bank alternatively may employ other actions to help mitigate increasing levels of risk". Therefore, stress testing is considered a complementary tool for other risk management approaches and measures that work to provide a forward-looking risk assessment that helps bank administration to overcome the limitations of models and historical data, which links internal and external communication through feeding in regulatory capital planning procedures and liquidity controls, which makes the bank aware of potential risks and prepare early to confront them through contingency plans.

It is noted that BCBS′s principles of 2009 regarding stress testing were aimed to address deep weaknesses in banking practices as appeared in the global financial crisis period. But in recent years the concept and role of stress testing has been developed to involve different models and significant methodologies of banking supervision for banking risk management. According to BCBSIII(2018), the definition and framework of stress testing have extended to include macro-prudential policies, approved objectives by the director board, document-supported institution structure governance, methods to measure risk management help in making decisions, ability to capture banking risks, supported by actual data based on strong IT systems, the data should fit the methodologies and objectives of stress testing itself, model findings should be subject to a systematic review and transparently published to stakeholders internally and externally. Thus, stress testing is one of the two pillars of comprehensive financial assessment of banks or non-banks financial institutions. It acts as an early warning, which is a financial health check that helps to ensure banks have enough capital to withstand possible financial shocks. The other pillar is a good (early) understanding of the test results and the speed of response in taking appropriate actions and decisions.

It may be useful to highlight that some financial institutions prefer to use the value-at-risk (VAR) technique. ECB (2001) defined VAR as the higher probable change in the value of financial instruments such as stock, bonds, and T-bills in an investment portfolio with a certain probability risk concerning a certain financial asset. It is measuring the financial (market) risk associated with financial investment portfolios. VAR as a quantitative method of measuring risk has many implementations especially the risk management applied to assess the probability of investment portfolios exposed to market risk, and the performance of risk bears between the financial institution, investor, and regulatory authorities.

Biery (2013) specified four methods of stress testing including 1. Transaction stress testing. It measures potential losses resulting from borrowing by evaluating the impact of economic conditions changes such as market risk on a borrower's ability to repay the loan, 2. The Bottom-Up Stress Testing. It refers to investment portfolio risk and identifies concentration risk on a certain financial asset by aggregating the stress test results of individual transaction-level relevant to the portfolio. On the other hand, Top-Down Stress Testing is based on evaluating the potential loss of the portfolio under one scenario or more to a set of assets that have common risk features and characteristics, 3. Sector/Enterprise-level Stress Testing. It takes into account the potential effects on the performance of a certain sector/ institution under a given scenario of macroeconomic conditions and expected banking and financial risks, and 4. Reverse Stress Testing. It is another method of Top-Down Stress Testing. It works backward to assess the expected risk that probably affects the institution or a certain sector due to a worse economic situation that could hurt it. Then it develops emergency plans to mitigate or avoid risks expected within the scenario.

Research by Martin & Anca (2010) evaluated the stress testing practices of Central Banks in Central and South Eastern Europe and discussed good practices and the applied approaches focusing on the main components of a typical macro-prudential stress test and estimating results indicators to help macro-prudential policymakers.

Natalia, Illyasov, Tsoy, & Shaikh (2010) examined the Kazakh Banking System for passing stress testing based on different methodologies including "bottom-up" and "top-down" approaches. The results show that banks tend to underestimate the decline in real estate prices and overestimate currency devaluation. As for the "top-down approach" based on portfolio investment analysis and macroeconomic situation, the results found that the change in the expected losses under stress ranges between 34 percent and 86 percent relative to the unconditional expected losses. The macro stress test finds an average change of 26 percent in the ratio of bad loans to total loans under stress scenario 1 and an average change of 80 percent under scenario 2 relative to the baseline scenario.

Oura et al (2012) defined stress testing as a technique that "measures the vulnerability of a portfolio, an institution, or an entire financial system under different hypothetical events or scenarios. It is a quantitative "what if" exercise, estimating what would happen to capital, profits, cash flows, of individual financial firms or the system as a whole if certain risks were to materialize".

Baudino et al (2018) determined three steps of any stress testing and linked them to the policy including governance (responsibilities and coverage), implementation (technical requirements and design), and outcomes (results and communication).

Shapiroy & Zeng (2019) concluded that stress testing may be (1) lenient, to encourage lending in the future, or (2) tough, to reduce the risk of costly bank defaults. (3) or maybe multiple equilibria and take its account the two first

points.

Mustafa (2019a) examined the trade-off between liquidity risk and maximizing profitability and its effect on banks' ability to provide finance to the economic sectors in Sudan during the period 2000-2018. The results found that ratio of liquid assets to total assets affect positively ability of banks to provide finance, while the return on assets had a negative impact. This means that the Sudanese banking sector unprofessionally works because customers' default probably reduces liquidity causing credit risk and consequently worsening profitability and the financial performance of banks.

Mustafa (2019b) tested the financial performance of Islamic banks in Sudan to pass credit risk and inflation pressures (1995-2017). The results found that inflation and credit risk indicators affecting negatively the financial performance of banks.

Mustafa (2020a) examined and explained how Islamic banks in Sudan were exposed to a liquidity shortage crisis in 2018. The main findings revealed that expansionary monetary policy indirectly contributed to the exposure of banks to liquidity shortage risk through money supply increase. Furthermore, hyperinflation encouraged customers to high cash withdrawals from their accounts; consequently, exposing banks to the crisis.

IMF (2020) in its study on stress testing in sub-Saharan Africa stated that "Spurred by the global financial crisis, stress testing has become an integral part of financial stability frameworks. Stress tests permit simulating the likely impact of assumed adverse economic and financial conditions on the viability of financial sector entities, particularly commercial banks".

Mustafa (2020b) used a simple regression model to answer the question of why Islamic banks in Sudan prefer to focus on providing financing by Murabaha mode during the period 2018-2020 and what are the expected risks. The results indicated that Islamic banks prefer the mode of Murabaha to ensure profits and reduce the default risk. Because they take sufficient collaterals. The expected risks occur when the market value of the collaterals reduces to a level lower than the principal, which exposes banks to credit risks.

AMF (2021) issued guiding principles on developing stress testing methodologies to assess financial sector risks in light of learning outcomes from previous financial crises.

Al-Qaisi and Al-Tahatmouni (2021) applied a stress test model to measure the impact of the financial crisis on Jordanian commercial banks. The results found that the Jordanian banking sector can withstand medium-term shocks that may result from the mismanagement of liquid assets.

This paper does not investigate the stress testing of a single bank or a sample of banks. But aims to examine the ability of the Sudanese banking sector as a whole to withstand sudden shocks and potential crises. Moreover, it provides the supervisory authority with relevant results and recommendations.

3. Methodology and Data

The study aims to examine the ability of the Sudanese banking sector to withstand sudden shocks and potential crises subject to prudential standards issued by BCBS. The methodology is based on the application of the "Top-Dow Reverse Stress Testing". It analyzes the performance indicators of the Sudanese banking sector (indices of consolidated balance sheet and financial soundness) within the performance of Sudan's economy. The analysis covers the period of 2005-2021 and beyond. The selected period involved important political and economic events that affected banks' performance in Sudan. In 2005 the Comprehensive Peace Agreement (CPA) has been signed in Kenya between South and North Sudan after a long civil war. The year 2007 witnessed the Global Financial Crisis. In July 2011 and due to a referendum enshrined in CPA, South Sudan seceded and became a new state. Therefore, data since 2011 and beyond indicate North Sudan. In 2018 a new wave of political instability swept North Sudan as the result of the Arab Spring Revolutions. The political system in North Sudan changed in April 2019 and unrest continues. The study follows four steps to conduct the stress testing as follow:

Step One: It presents a picture of the performance of the Sudanese economy based on key macroeconomic indicators such as growth domestic product (GDP) growth, inflation rate, exchange rate, per capita income, and external debt. If these indicators perform low, they will affect the financial performance of banks as well as their ability to overcome difficult circumstances.

Step two: It provides background on the structure of the Sudanese banking sector and consolidated balance sheet Indicators. They are financial ratios that indicate the contribution of the depositors' funds and equity in financing the bank's capital structure including the Total Deposits to Total Liabilities ratio (TD/TL): Which measures the extent of banks' dependence on depositors' funds, Capital, and Reserve to Total Liabilities ratio (C&R/TL): Which is an indicator of the extent of depositors' contribution to financing assets compared to equity and its decline leads to high risks for depositors, Total Finance to Total Assets ratio (TF/TA): It reflects the extent to which assets are used to providing financing and generate profits, and Total Finance to Total Deposits ratio (TF/TD): It measures the extent to which

depositors' funds were used by the bank in providing financing.

Step three: It examines the ability of financial soundness indicators of the Sudanese banking sector to pass the stress testing criteria emphasized by Basel I and II. These criteria include **1**. Capital Adequacy indicators, which include **a**. Capital Adequacy Ratio(CAR): It measures the bank's ability to maintain regulatory capital qualified to face financing, market, exchange rates, and banking operational risks, **b**. Non-Performing Loans to Total Financing Ratio (NPL/TF): It measures the quality of assets and non-performing financing, **c**. Financing Provisions to Non-Performing Loans ratio (FP/NPL): It measures the ability of banks to cover the risks of losses resulting from defaulted financing and those whose recovery is doubtful). **2**. The liquidity index, which includes the Liquid Assets to Total Assets ratio (LA/TA): It measures the extent of the bank's ability to maintain liquidity or liquid assets when necessary to confront the risks of lack of liquidity. **3**. Profitability indicators, including **a**. Return on assets (ROA): It measures the ability of banks to generate profits from the use of their assets, and **b**. Return on equity (ROE): It measures the bank's ability to generate profits from each unit of shareholders' equity, i.e. the extent of capital adequacy).

Step four: It develops a scenario of reverse stress testing to show how the Sudanese banking sector performed with worsened political and economic changes during 2022-2025. The scenario examines the banking sector's ability to withstand shock in light of an expected decline in the performance of Sudan's economy during the four years following 2021. The hypotheses that the study tries to test assume that the Sudanese Banking Sector cannot bear sudden shocks and crises. Furthermore, there is a significant interaction between the performance of the banking sector and changes in the political and economic conditions of Sudan. The CBOS's annual reports (2005-2021) and estimated data for the years 2022-2025 are the core sources of secondary data used to test the hypotheses.

4. Results and Discussion

4.1 Performance of Sudan's Economy and Political Situation (2005-2021and Beyond)

Sudan is an Arab African country (Afro-Arab) geographically located in northeastern Africa. It is the third-largest African country in terms of area. Sudan is bordered to the east by Ethiopia and Eritrea, to the north by Egypt and Libya, to the west by Chad and the Central African Republic, and the south by the State of South Sudan as a result of the civil war that led to the secession of the south in 2011 (Mustafa, 2020c). The latest political conflicts coincided with the Covid-19 pandemic and ended with the fall of President Omar Al-Bashir in April 2019. Since then, Sudan has been facing a political vacuum and a fragile transitional authority. The latest war started in Khartoum the capital city of Sudan on 15 April 2023 and has spread to some states of Sudan as a result of political incompatibility. The war is still ongoing and Sudan continues to suffer political turmoil and an economic situation imbalanced.

Table 1. Key Indicators of Sudan's Economy (2005-2021)

Year	Real GDP Growth %	Inflation Rate (CPI)%	Exchange Rate (SDG /USD)	Per Capita Income $	Debt Servicing Standardized Ratio %30
2005	8.1	8.5	1.4	NA	53
2006	9.3	7.2	1.7	NA	55
2007	10.9	7.5	1.6	NA	63.8
2008	4.6	12	1.9	NA	64.7
2009	6.2	14	2.4	NA	58.3
2010	3.9	13	2.3	1637	59
2011	-3.2	18.1	2.88	1034	57
2012	-17.0	17	4.40	1396	61.7
2013	2.0	22.9	5.70	1463	70.7
2014	4.7	25.7	6.04	1629	52
2015	3.7	12.6	7.50	1679	51
2016	3.9	30.6	15.15	1639	40
2017	4.7	55.6	21.6	1173	45
2018	2.8	72.9	46.5	855	102.2
2019	-1.3	57.1	163.3	297	145.8
2020	-1.6	269	262	183	88.2
2021	-1.9	318	442	324	200.8

Source: CBOS, 2021 and IMF, 2021

Table 1 illustrates the performance of the Sudanese economy and gives a clear picture of the external environment in which the Sudanese banking sector operates and which affects its activity. The performance indicators during 2005, 2007, 2011, 2018, and 2019 demonstrate that Sudan's economy was negatively affected by the general events represented in the signing of the peace agreement, the global financial crisis, the secession of South Sudan, the fall of the ruling regime, and the COVID-19 pandemic, respectively. Anyhow, whenever the economy performs well, this helps the banking sector to overcome crises and withstand pressures.

4.2 Background on the Structure of the Banking Sector in Sudan

The banking sector in Sudan consists of the Central Bank of Sudan (CBOS), specialized banks (agricultural, real estate, and industrial), and commercial banks. Table 2 gives background on the development the of Sudanese banking sector since 2005 and beyond.

Table 2. Structure of the Banking Sector in Sudan (2005-2021)

(Number)

Year	Central and its Branches	Operating Banks					Total Banks (1)+(2)
		(1) Specialized Banks		(2) Commercial Banks			
		Joint*	Government	Joint*	Government	Foreign	
2005	12		3		26		29
2006	12		3		26		29
2007	12		3		29		32
2008	12		4		31		35
2009	14		4		34		38
2010	14		4		35		39
2011	10	2	3	23	1	4	33
2012	15	2	3	23	1	6	35
2013	16	2	3	24	1	7	37
2014	17	2	3	24	1	7	37
2015	17	3	3	22	1	8	37
2016	17	1	4	24	1	7	37
2017	17	1	4	24	1	7	37
2018	17	1	4	24	1	7	37
2019	17	1	4	24	1	7	37
2020	17	2	3	23	1	9	38
2021	17	2	3	23	1	9	38

Sources: CBOS, Annual Reports (2005-2021). * Joint Banks are banks where their Capital is joined between several parties either local (public or private) or foreign.

As seen in Table 2, the branches of the CBOS and the number of operating banks increased from 12 branches and 29 banks in 2005 to 14 branches and 39 banks in 2010, respectively, which indicates that the global financial crisis did not negatively affect the structure of the Sudanese banking sector. However, in 2011, the branches of the CBOS and commercial banks decreased to 10 branches and 33 banks, respectively, due to the secession of South Sudan. The branches of the CBOS also increased to 17 in 2021 compared to 38 operating banks in the same year. It is also noted that the Covid-19 pandemic in 2019 did not negatively affect the sector structure.

4.3 Consolidated Balance Sheet Indicators of Banks in Sudan

The importance of analyzing the indicators of the consolidated balance sheet of the banking sector stems from the fact that they provide an idea of how banks manage their internal resources (capital and reserves) and external (customer deposits). They provide also initial indications of the risks that the sector may fall into as a result of the utilization of its funds.

Table 3. Consolidated Balance Sheet Indicators of Banks in Sudan (2005-2021)

Year	(C&R/TL)%	(TF/TA)%	(TF/TD)%	(TD/TL)%
2005	13.8	45.7	71.6	59.41
2006	16.8	48.1	90.5	53.2
2007	17.6	49.6	93.2	53.2
2008	17.1	48.8	90.6	53.9
2009	18.2	49.5	87.1	60.0
2010	17.3	47.8	79.6	59.7
2011	19.4	49.2	82.3	59.7
2012	16.2	45.5	76.4	59.3
2013	17.0	48.6	84.5	57.5
2014	16.0	48.0	82.9	57.9
2015	14.9	49.1	84.3	58.2
2016	13.9	51.0	85.2	59.9
2017	10.8	48.7	73.5	66.3
2018	6.90	36.5	54.8	68.4
2019	10.6	39.7	59.5	66.7
2020	7.7	36.9	54.0	68.3
2021	6.9	29.3	49.5	59.3

Sources: CBOS, Annual Reports, (2005-2021).

Table 3 shows that the banking sector in Sudan relies heavily on deposits to operate its activity. Where the financing provided based -on customers' deposits in some years reached 90% in 2008. Here the risks lie in the possibility of the sector being exposed to credit risks. On the other hand, the capital and reserves cover about 6%-17% of the total liabilities. As the asset-based financing granted index (TF/TL) decreased from 45% in 2005 to 29% in 2021, the sector's ability to operate funds is declining. In general, the consolidated balance sheet indicators tend to decline with time since the secession of South Sudan in 2011. As well as the changes in the political regime in 2018 and the repercussions of the Corona pandemic in 2019 hurt the performance indicators of the balance sheet.

4.4 Banking Soundness Indicators of Banks in Sudan and Stress Testing

Banking soundness indicators are international financial criteria used to measure the ability of banks to pass stress testing and confront risks. A good implementation of these criteria leads to maintaining financial stability and ensuring the banking system's efficiency. They also aim to protect stakeholders of the banking system (regulators, banks, and depositors) from exposure to banking risks (credit, liquidity, market, and operational).

Table 4. Financial Soundness Indicators of the Sudanese Banking Sector (2005-2021)

Year	CAR% Minimum Standardized Ratio 8-12%	(NPL/TF) % Maximum Standardized Ratio 6%	(FP/NPL) % Min-Max of Standardized Ratio 60-70%	ROA% Minimum Standardized Ratio 1.25%	ROE% Standardized Ratio Not Specified Internationally	(LA/TA) % Min-Max of Standardized Ratio 30-40%
2005	19	14	19	1.4	7.6	17.4
2006	27	19	3.2	2.1	19.2	17.0
2007	25	17	24	2.5	21.0	21.0
2008	12	15	27	1.4	22.8	20.9
2009	11	15.1	29	3.4	24.6	27.6
2010	10	14.1	31.1	3.9	26.5	22.5
2011	13	12.6	39.7	4.20	28.8	32.0
2012	12	11.9	36.4	4.40	36.5	41.5
2013	16.6	8.40	37.0	3.70	29.6	39.0
2014	18.0	7.10	61.7	4.00	33.7	39.1
2015	20.2	5.10	90.7	4.00	37.1	37.4
2016	18.7	5.20	60.0	4.70	46.1	35.1
2017	16.2	3.30	81.3	3.80	48.0	37.3
2018	9.9	3.20	72.0	4.70	94.7	51.6
2019	14.1	3.5	74.0	3.4	42.9	49.5
2020	11.5	3.5	59.8	3.1	60.7	53.7
2021	7.1	3.7	77.0	4.9	80.3	62.0

Sources: CBOS, Annual Reports (2005-2021)

According to the latest annual report of the CBOS for the year 2021 published in 2022, Sudan applied Basel I principles related to capital adequacy to confront risks that threaten the financial soundness of banks. As for Basel II and Basel III concerning liquidity risks and financial leverage, Sudan has not applied these standards yet. The application was limited only to the first pillar of capital adequacy. Basel I specified that the minimum allowable capital adequacy should not be less than 8%, while the supervisory authorities in Sudan took more precautionary standards. Where obliging banks apply minimum capital adequacy of not less than 12%.

Table 4 indicates that the Sudanese banking sector is facing difficulty in sustaining the financial soundness indicators within the standard limits recommended by Basel I and II. Although the capital adequacy (CAR) was within the permissible limits, it failed to pass the stress test, as it fell to 7% in 2021. This means that banks may expose to credit and operational risks. Since 2015, the non-performing debts continue to decrease reaching 3.7% of the total financing in 2021, compared to the upper limit of 6%. This reflects efforts made by the regulators and banks' boards of directors in following up on the recovery of loans and credit. On the other hand, the banking sector failed to pass the stress test of maintaining financing provisions ranging between 60-70% of bad debts. It increased during the last four years until reached 77% in 2021, which is a clear indication that banks have something to worry about in debt recovery and may have entered the stage of risk of default. Regarding liquidity management and profitability, it is noted that the banking sector has succeeded in maintaining higher levels than the minimum prescribed rate of return on assets. Then again, liquidity risks increased, as the ratio of liquid assets to total assets (LA/TA) remained below the permitted minimum of 30% during the period 2005-2010. While it rose outside the recommended upper limit of 40% during the period 2018-2021. This indicates that banks failed to pass the stress test of liquidity risks during the period of political instability that Sudan witnessed in 2019. This result does not agree with Al-Qaisi and Al-Tahatmouni (2021) because the Jordanian banking sector succeeded to withstand medium-term liquidity risk while the Sudanese banking sector since 2018 suffered a mismanagement of liquidity risk due to political unrest.

4.5 Reverse Stress Testing Scenario for the Four Years Following 2021

The Top-Down Reverse Stress Test Scenario is designed on the assumption that the economic and political conditions in Sudan will continue to worsen. It is a hypothetical stress test, pointing to capturing worse expected events that had not yet occurred. The dispute between the Sudanese Transitional Sovereignty Council Chairman (Commander-in-Chief of the Armed Forces) and its deputy (Commander of Rapid Support Forces) on the terms of The Framework Agreement, most notably the period scheduled to integrate the Rapid Support Forces into the Armed Forces, was the main reason of the recent fighting in Sudan (UN, 2023a). On April 15, 2023, the war between the Sudanese army and the Rapid Support Forces broke out in Khartoum and spread to the Darfur region in western Sudan. The fighting has also resulted in hundreds of civilians killed and thousands injured. While thousands of people compulsorily left their homes in search of a safe place (UN,2023b). It is axiomatic that wars and conflicts disrupt life and affect the performance of the economic sectors (production, services, banking, etc.). Therefore, the conflict in Sudan led to the cessation of electricity, communication, and internet services, the closure of all operating banks in Darfur and Khartoum states, including the Central Bank of Sudan, and the looting of most of them. On May 14, 2023, the governor of the Central Bank of Sudan was dismissed, and the banking system became almost paralyzed as a result of the suspension of most banking services and transactions. This situation embodies the risks of political instability, which quickly turn into economic crises affecting the banking sector. This scenario examines the stress that the Sudanese banking sector may face due to the expected drop in the performance of the Sudanese economy in the four years following 2021. BCBSIII (2018) emphasized in principle No.3 that stress testing should be used as an expected risk management instrument, to inform business decisions, and to make appropriate decisions at the right time. The scenario provides projections with suggested recommendations to help banks and regulators prepare for the management of the worst expected banking risk in Sudan.

Table 5. Sudan's Economy: Projected Indicators (2022-2025)

Year	Real GDP Growth %	Inflation Rate (CPI)%	Exchange Rate (SDG /USD)	Per Capita Income $	Debt Servicing Standardized Ratio %30
2022	-2.0	320	480	300	220
2023	-2.2	350	605	280	240
2024	-2.4	335	650	250	280
2025	-2.5	400	700	180	300

Sources: Author-Projected Values based on the Annual Report of the CBOS 2021 and War effect.

As shown in Table 5, as a result of the production sector being affected by the ongoing war in Khartoum state, the negative growth of Sudan's economy is expected to continue during the next two years to reach -2.5% in 2025. Consequently, per capita GDP probably decrease from $220 in 2023 to $180 in 2025. Sudan is one of the poor countries with heavy foreign debt, which amounted to $49.8 billion at the end of 2019. On March 23, 2021, at the request of Sudanese Prime Minister Dr. Abdalla Hamdok, the WB and the IMF considered Sudan eligible for the forgiveness of its foreign debt under the Enhanced Heavily Indebted Poor Countries (HIPC) Initiative (World Bank, 2021). The October 25, 2021 coup carried out by the Commander-in-Chief of the Armed Forces, under which the Prime Minister was arrested, undermined these efforts. Therefore, the expected drop in GDP growth is probably rising debt service to 300% by 2025 compared to the standardized rate of 30%. Due to the disruption of product supply chains, the inflation rate is estimated to rise from 335% in 2024 to 400% in 2025 compared to 350% in 2023. Since the secession of the south in 2011, Sudan lost 75% of its oil export. Therefore, a further devaluation in the local currency is expected and may push the exchange rate to 700SDG/USD in 2025 compared to 605SDG/USD in 2023.

Table 6. Estimated Geographical Distribution of Banks Branches: 2022-2025

State	2021		2022		20 April 2023		2024		2025	
	No.	%	No.	%	No.	%	No.	%	No.	%
Khartoum State	384	44.4	384	44.4	0	0	38	4.4	150	17.3
Central States	160	18.5	160	18.5	160	18.5	160	18.5	160	18.5
Eastern States	93	10.8	93	10.8	93	10.8	93	10.8	93	10.8
Northern States	86	9.9	86	9.9	86	9.9	86	9.9	86	9.9
Kordofan States	77	8.9	77	8.9	77	8.9	0	0	10	1.2
Darfur States	65	7.5	65	7.5	0	0	0	0	0	0
Total Branches	865	100	865	100	416	48.1	377	43.6	499	57.7

Sources: Author-Projected Values based on the Annual Report of the CBOS 2021 and War effect.

Table 6 shows the expected negative impact of the war on the geographical distribution of bank branches in the different states of Sudan. Before the war, the state of Khartoum alone accounts for 44.4% of the total branches in the sector during 2021-2022. While branches operating in the states of Darfur represent 7.5% for the same period. The war

broke out in Khartoum and moved to the states of Darfur in western Sudan. Since April 20, 2023, all bank branches operating in the states of Khartoum and Darfur have completely gone out of service. Meaning that the war has caused the suspension of 51.9% of the banking sector's capacity, including the Central Bank of Sudan. The war is likely to spread to Kordofan state, which is adjacent to West Darfur state. And so, the capacity of the banking sector is projected to decrease to 43.6% in 2024. The banking sector may begin to gradually recover in 2025. The number of operating branches is expected to increase to reach 57.7% of the total branches by the end of 2025.

Table 7. Expected Financial Soundness Indicators of the Banking Sector in Sudan (2022-2025)

Year	CAR% Minimum Standardized Ratio 8-12%	(NPL/TF) % Maximum Standardized Ratio 6%	(FP/NPL) % Min-Max of Standardized Ratio 60-70%	ROA% Minimum Standardized Ratio 1.25%	(LA/TA) % Min-Max of Standardized Ratio 30-40%
2022	6.8	4.0	80.0	4.0	65.0
2023	6.5	6.7	90.0	1.5	68.0
2024	6	8	92.0	2.5	69.0
2025	6.2	10	85.0	3.00	72.0

Sources: Author-Projected Values based on the CBOS Annual Report, 2021 and War effect.

Table 7 shows the expected negative impact of the war in the states of Khartoum, Darfur, and Kordofan on the financial performance of the Sudanese banking sector. Capital adequacy is expected to reduce to 6% in 2024 compared to 6.8% in 2022. While it improves slightly to 6.2% in 2025, compared to the standard ratio set by Basel II for stress testing of 8%. This indicates that the Sudanese banking sector may expose to credit, operational, and liquidity risks due to the low ability of the regulatory capital to overcome the stress testing and confront the shocks that the war will generate. The war caused most of the production sector to stop and reduced income levels and the customers' ability to repay financing to banks, which raises the default risk. It is also expected that the ratio of non-performing loans to total financing and the ratio of financing provisions to non-performing loans will rise.

The war caused an outage of electricity, the Internet, and the national payment system. Banks were forcibly closed and all their electronic services, including digital money and transfers, were suspended. All mobile banking applications are also suspended, and ATMs are out of service and empty of money. Citizens suffer from a lack of cash to provide the necessities of life. One of the risks surrounding banks is that depositors may rush to withdraw their money when the banking network returns to work. Banks fear a run because it causes rapid collapse due to their inability to meet the expected huge demand for cash. The ratio of financing granted to total deposits reached nearly 50% in 2021 and is expected to be very high during 2022. Therefore, the banking sector is highly exposed to liquidity risks in 2023.

5. Conclusion

The paper aims to examine the resilience of the Sudanese banking sector to pass stress testing and withstand sudden shocks and potential crises for the period 2005-2023 and beyond. The test was dependent on analyzing the economic indicators of Sudan, consolidated balance sheet indices, and financial soundness standards of the Sudanese banking sector. A hypothetical reverse stress testing scenario has been designed and includes estimated data for the worst possible changes in the political and economic environment that could hurt the banking sector in Sudan during the period 2023-2025. The finding found that:

- The Sudanese banking sector is not qualified to withstand sudden shocks and pass the stress testing standards recommended by Basel I and II. This is attributed to the continuous deterioration in the political and economic environment.
- The results of the stress test of the consolidated balance sheet indicators showed that the banking sector relies a lot on customer deposits to provide financing, reaching 90% of the total deposits in 2008. While capital and reserves cover 6-17% of the total liabilities of banks indicating the low ability to bear the credit and operational risks if they occur.
- Basel II set 8% as the minimum capital adequacy. while the banking sector in Sudan achieved 7.1% in 2021, Which indicates the inability of the regulatory capital to bear banking risks. And expected to range between 6.2% and 8.6% during 2023-2025 due to the political turmoil.
- Despite the ratio of bad debts to total financing declined during 2015-2021 compared to the maximum limit of 6%. But it is expected to rise between 6.7% and 10% during 2023-2025, due to the negative impact of the war in Khartoum on the performance of the banking sector.
- Political instability and the fall of the ruling regime in 2019 negatively affected the optimistic view of banks regarding loan recovery. The financing provisions to bad debts ratio increased to 77% in 2021 compared to the

standard rate (60%-70%). These provisions are expected to rise to 92% and 85% in 2024 and 2025, respectively due to the deterioration of the political situation and the war in Sudan.

- The war of the fifteenth of April 2023 led to the closure of all bank branches operating in the states of Khartoum and Darfur, which represent 51% of the banking sector size. It is expected that the operational capacity of bank branches will decline to 43.6% in 2024 leading to a decrease in the return on assets by 2.5% for the same year. But the year 2025 may witness a slight improvement in the return on assets and probably reach 57.7%.
- The most prominent problem that the Sudanese banking sector has been suffering is the mismanagement of liquidity. Basel II specified that the standard ratio of liquid assets to total assets should range between 30%-40%. But in practice, it ranged between 49%-62% during the period 2018-2021. It is expected that the operational risks of liquidity management will exacerbate in 2023 and beyond due to 50% of the banking sector's branches stopping providing banking services.
- The Sudanese economy also suffered chronic imbalances during the period 2005-2021. Most notably the negative GDP growth, the decline in per capita GDP, the continuous rise in inflation rates, and the deterioration of the exchange rate. It is not expected that the performance of the Sudanese economy will be better than its predecessor during 2023-2025 due to the war and its negative impact on the production sector. This situation puts the banking sector in constant confrontation with market risks and price volatility.
- The main recommendation of the paper refers to the need for the Monetary Authority (Central Bank of Sudan) to follow up on the commitment of banks to apply the stress testing standards recommended by the BCBS. Moreover, apply of contractionary monetary policies reduces inflationary pressures, which helps banks to relatively recover and mitigate market risk.
- Authorities and banks should apply stress testing regularly and ensure that results are reported to the board management and issued appropriate decisions timely.
- The war in Sudan shed light on the need for the Central Bank of Sudan to reconsider evaluating the risk management surrounding the banking sector resulting from changes in the political and economic environment.
- In 2023, the states of Khartoum and Darfur acquired half of the branches of banks operating in Sudan and some of them were looted and burned. It is feared that the inability of depositors to withdraw funds will undermine their confidence in the banking system. Therefore, the Central Bank of Sudan must work, in coordination with operating banks, reassures depositors and educates them that their withdrawals should be as much as they need. Thus, reducing the possibility of the banking sector's exposure to the banks' run.

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